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Banyan tree-the sacred medicinal tree with potential health and pharmacological benefits

Abdalsalam Kmail[1], Farwa Asif[2], Rafia Rahman[2], Shafaq Nisar[2]*, Muhammad Idrees Jilani[2]

[1]*Faculty of Science, Arab American University, Palestine, P.O. box 240, Jenin Palestine and* [2]*Department of Chemistry, University of Agriculture, Faisalabad, Pakistan*

Abstract

Ficus bengalensis or Banyan tree is a perennial plant, which belongs to the mulberry family (Moraceae). Around 800 species of *Ficus* are present. This tree is native to the India and old world tropical areas. It has been cultivated throughout the world and used for thousands of years as ornamental plant and in traditional medicine. It contains flavonol, querecitin-3-glactoside, β sitosterol and rutin. The extent of each of these chemical constituents varies depending on the type of species, cultivars as well as cultivation conditions such as soil type, weather and pH of soil where it grow. Banyan is an essential plant for several pharmaceutical industries. The roots of *Ficus bengalensis* are used for obstinate vomiting and infusion. The bark is considered as a tonic and astringent. It is also used in diarrhea, dysentery. In Ayurvedic system, the bark is used in the treatment of diabetes. It is necessary to intensify the studies on Banyan, especially the chemical composition and to conduct in-depth studies at the molecular level both *in vitro* and *in vivo* to reveal the action mechanisms of this traditional plant.

Key words: Moraceae, Flavonoids, Derivatives, Jaundice, Medicines

Full length article **Corresponding Author*, e-mail: shafaqnisar12@gmail.com, Tel: +923237628206

1. Introduction

Banyan *(Ficus Benghlensis* L. (FB) is a large plant and is a member of the family Mulberry (Moraceae). It has been used for thousands of years and has become an essential plant in the medicinal field. Banyan varies in morphology, growth habit, flower color, leaves, stems, and chemical composition. It is available throughout the year in different regions of the world. It grows in evergreen except in some dry areas where it remains leafless for a very short time due to dryness and shortage of water. FB (Banyan tree), *Ficus carica* (Anjir tree) and *Ficus Religiosa* (Pipal tree) are species that are common in the genus Ficus, which is classified in the family Moracea [1]. FB has different names depending on the region of the world where it is existing. In English, FB typically is called Banyan, the common name is Bohr. In India, specifically, Hindi native speakers, it is called Bargad. In different places of India it has different names such as, in Punjab it is known as Bera, in Bengali it is known as Bar, in Malayalam it is called Vatam, in Gujarati it is commonly called Vad, in Kanarese it is famous by the Ala name , in Marathi it is called Vada, in Sanskrit it is called Bahupada, in Tamil it is called Alai and in Telugu it is called Peddamarri [2]. Probably, the most famous characteristic of banyan is its beautiful flavor. FB has a wide range of varieties and cultivars, varying in flavor and uses. The popular example includes *F. macrophylla*, *F. microcarpa* and *F. pertusa*. The shortleaf fig plant (*Ficus citrifolia*) is native to different region of the world such as southern Florida, South America, south to Paraguay, the Caribbean Islands and Central America. But among these spices, the most common is banyan tree. Banyan has an epiphytic nature. It has large spreading head; it can grow 20 - 30 meters or more. Flowering occurs from May to August. The banyan tree has leaves, which are very large, glossy green, leathery and elliptical in shape. Young leaves seem to be an attractive reddish tinge. FB fruit color at ripening time change from orange to red. It is also used as ornamental plant in different regions of the world [3].

The essential oil, which extracted from FB has different compounds such as sesquiterpene and monoterpene, as well as α-cadinol, γ-cadinene, α-muurolene and germacrene-D-4-ol. FB also has tannins, sterols, phenols, ß flavonoids and saponins in large amounts. Some compounds such as aromatic acids, triterpenoids, mucilage, carbohydrates, gums and volatile oils are totally absent in the leaf extract of this plant [4].

2. History/Origin

FB is native to a wide area of Asia from India through Myanmar (Burma), Thailand, Malaysia, Southern China and Southeast Asia. The name; *F. benghalensis* was

originated in India. In the Gujarati language, "*banya"* means "grocer or merchant", which is not "tree". The Portuguese used this word to show the Hindu's merchants, and it entered into English as early as 1599 with the same meaning and became popular. In 1634, English writers started to call the banyan tree as a tree. Under the shade of this tree, Hindu merchants sat and offered their business. Villages meetings also held under the shade of this tree. Eventually, "banyan" became the name of the tree itself [5]. In Australia Banyans also commonly endemic, also it can be found in different areas such as raintree and rainforest in Queensland's far north [6]. Some people are being scared from Banyan tree and called it the *vat Vriksh*, others believed that the God Shiva was always descend quietly and stood under the tree on his feet.

3. Demography/location

FB needs moisture for its proper growth. However, the plant is a drought tolerant; it can grow in sun and also in partial shade. Banyan tree is easily damaged by frost; therefore, it grows better in warmer climates. As said before, this plant is native to the Asia-Pacific subcontinent, it is a widely distributed all over India as well as in southern China, Myanmar (Burma), Thailand, and Malaysia. Globally it is distributed in Miami, Florida, Guam, Fiji, Queensland, Northern Mariana Islands, and French Polynesia [7].

4. Botany, Morphology, ecology

FB is a huge evergreen tree, its height ranges from 20 to 30 m. It has large spreading branches supported by aerial roots, later on it forms accessory trunks extending to a large area and stout, softly branchlets and leaves have green color. FB tree has simple, alternate, 10-20 cm long leaves. Its leaves are 5-12.5 cm broad, orbicular-ovate oval, ovate to oblong, the leaves are coriaceous, obtusely cuspidate, glabrous or pubescent beneath, base rounded, sub cordate or acute. Basal veins are strong, lateral veins have 7-8 pairs, the veins are also reticulate. Petioles are 1.2-5 cm long, while stipules 1.8-2.5 cm long. FB has minute and unisexual flowers of 3 kinds; both male and female flowers are present, in addition to the imperfect females (gall flowers) which are crowded along with bracteoles in the inner walls of fleshy receptacles. Fleshy receptacles are sessile, globose, about 1.8 cm in diameter; these are arising in axillary pairs. Basal bracts are present profusely in the tree. Male flowers are present near the mouth of the receptacles, as well as the non-reproductive perianth and stamen filaments that are also existing in the tree. Female flowers are also having perianth but that are shorter than the male perianth. The ovary is superior and unilocular with a single pendulous ovule, straight or oblique with eccentric style, the stigma is very simple. Fruits of FB have fleshy pericarp with achenes embedded in them [8]. Figs globose are depressed-globose and reach a size of 15-2.5cm, the fruits color is dish-red [9].

FB is best cultivated in wet habitats and on well-draining sandy loam soils. It grows best in sandy soil whereas it is drought-resistant. The banyan tree grows effectively in moderate bright light, it also maintain indoor temperatures around 70 F during summer days (at least temperature which it bears is 55-65 F). It grows well in soil which has pH in the range between 5.5 and 7. Even so, it can tolerate pH ranges from 4.5 to 8.5.

5. Chemical composition

FB has a green pale, fine and odorless powder which is slightly acrid and sweetish in taste. The microscopic powder shows the presence of trichrome and fibers. Many qualitative chemical analysis tests on FB were done, the ethanolic extracts indicates the presence of sterols, flavonoids, phenols, tannins, and saponins in large amounts [10]. Extracts of the stem bark showed that various chemical components are present such as methyl ethers of leucodelphinidin rhamnoside, leucopelargonidin rhaamnoside, lecocyanidin, galactosylcellobioside, pentatriacontan-5-one, tetratriacont-20-en-2one, heptatriacont-6-en-10-one, beta-sitosterol glucoside and iso-inositol. However the main chemical compounds that were found in the essential oils of the banyan are, sesquiterpene α-cadinol (25.1%), germacrene-D-4-ol (14.9%), γ-cadinene (11.8%) and α-muurolene (9.6%) [4].

5.1. Chemical composition in low quantities

FB has low fat content; it has also low amounts of Mg and Ca. The leaves have little amounts of stored crude protein, fibers, calcium oxalate, CaO and phosphorous, the flavonols are also identified in leaves, as well as quercetin-3-galactoside and rutin. FB yields latex which contains sugar caoytchoue (2.4%), resin, albumin, cerin and malic acid [4].

5.2. Phytochemistry

Studies revealed that leaves of FB plant contain quercetin-3-galactoside, rutin, friedelin, taraxosterol, lupeol (Figure 1), β-amylin, psoralen, bergapten, β-sisterol, and quercetin-3-galactoside. The latex contains the caoytchoue, resin, albumin, cerin, sugar, and malic acid [10]. The bark of FB have 5, 7 dimethyl ether of leucopelargonidin-3-0-α-L rhamnoside and 5, 3 dimethyl ether of leucocynidin 3-0-α-D galactosyl cellobioside, beta sitosterol-alpha-Dglucose, as well as meso-inositol. Earlier, glucoside, heptatriacontene-10-one, tetratriaconthene-2-one, 6-heptatriacontene-10-one, βsitosterol-alpha- Dglucose, andmeso-inositol, leucodelphinidin derivative, bengalenoside, aglucoside, leucopelargonin derivative, leucocynidin derivative, and glycoside of leucopelargonidin.[11]. FB is unusual rich source of oil containing fatty acids which can be used for industrial utilization. Usually, GC-MS analysis is used to find out the chemical profile of seed oil [12-14], which was showed to contain vernolic acid (8.2%), malvalic acid (3.7%) and sterculic acid (1.6%) along with the other normal fatty acids like linoleic acid (15.4%) lauric acid (1.5%), myristic acid (1.3%), oleic acid (20.3%), palmitic acid (35.2%), stearic acid (4.2%), and linolenic acid (8.7%) in

addition to vernolic, malvalic, sterculic and some other normal fatty acids.

6. Harvesting and extraction

The aerial roots and stem parts are best to be harvested on January [15]. The isolated stem bark is dried in shade and converted into powder until use for various applications. The extract of the FB leaves can be prepared by maceration at room temperature, then the plant material soaked successively in petroleum ether, chloroform and methanol. The solvent removed by the use of a rotatory evaporator to give different sticky crude extractions which can be used in various applications [15].

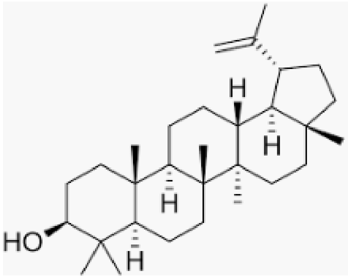

Figure 1: Structure of Lupeol

8. Additional value

FB trees are planted for soil conservation and to save it from scattering. Woods of the trees are used to make strong curbs, furniture, and in the paper pulp manufacture. Leaves are used in the fodder (i.e. Crude protein 9.63%). Fruits are used to make traditional Sherbet [16]. Besides, bark is used in traditional medicine as an antidiabetic and antidiarrheal therapy.

9. FB and medicine

Banyan parts are used as a medicinal plant in different traditional medicines. The plant has the capability to produce variety of chemical compounds that are used in different significant biological activities. It provides a shield against attack from predators such as insects, fungi and herbivorous mammals. Most phytochemicals in banyan shows significant effects on long-term health when disbursed by humans, and could be used effectively to treat human disorders. The plant has chemical compounds which arbitrate their properties on the human body through processes alike to those already known in the manufactured drugs. People prefer to use medicines of herbal origin compared with modern drugs because of their minimal side effects [17].

9.1. General uses

Many of the therapeutic properties of FB have been attributed to the diverse compounds of polyphenols. Bioactive peroxides are used as anticancer, antiviral [12-18-19], antidiabetic, and against malaria, as well as cardio-protective, hepato-protective, and neuroprotective effects. According to Ayurvedic system of medicines, bark, fruits, and aerial roots of FB are used for the curing diabetes. Leucopelargonin are flavonoids which are used as worthy hypoglycemic agents and as antioxidants. The bark of FB antipyretic, antiseptic, and vermicide activity, decoction of the bark is used to cure different skin disorders and ulcers. It is used as a plaster in the inflammatory swellings. It is effective in the curing of asthma, piles, dysentery, gonorrhea, hemoptysis and also in urinary disorders [20]. The decoction of leaf, buds, and aerial roots of Nyagrodha were mixed with honey and used for the treatment of vomiting and thirst. The leaves are used for ulcers, leprosy, burning sensations, allergic situations of skin and abscesses. The buds are used in diarrhea and dysentery. The latex is used in neuralgia, otorrhagia, lumbago, bruises rheumatism, nasties, ulitis, odontopathy, hemorrhoids, gonorrhea, and inflammations. For some skin disorders, it is widely used in cracks of the sole [21].

9.2. Biological activities

In traditional system of medicine, different parts of FB plant, such as, stem bark, root bark, leaves, vegetative buds, fruits and latex are used to treat dysentery, nervous disorders, diarrhea, diabetes, leucorrhoea, menorrhagia, and acerbic [22-23]. In Ayurvedic system of medicine, FB is used in wound healing [24].

9.2.1. Antioxidant

Ficus compound shows significant antioxidant effects which may due to their Polyphenolic content [25]. Antioxidants content and activity were studied by different methods; hydrogen peroxide activity, hydroxyl radical scavenging activity, 1,1 diphenyl and 2 picryl hydroxyl (DPPH) radical scavenging activity, reducing power and total phenolic content. The aqueous extracts showed a maximum scavenging of DPPH radical (96.07%) at the concentration 250μg/ml. Its activity is higher than hydrogen peroxide which was (69.23%) at the concentration 1000μg/ml. The extract of banyan showed the best outcomes when compared with other standard compound such as ascorbic acid [26].

9.2.2. Antitumor

In another study, FB fruit extracts exhibited antitumor action. In Aryuvedic system of medicine, banyan plant is used as an antitumor agent. The extracts of the four confirmed ficus species (*Ficus thonningii, F. saussureana, F. exasperata* and *F. sur)* has important antibacterial activity, but with no significant antifungal effect. These experiments supports the traditional use of these plants in folk medicines as an antitumor remedies [16].

9.2.3. Anthelmintic

It was found that methanolic, chloroform and ether extracts of the FB roots has an effective anthelmintic action when compared to that of conventionally used drugs. It was analogous to typical Anthelmintic drug [27].

9.2.4. Anti-inflammatory

Anti-inflammatory effects of ethanolic and petroleum ether extracts of the bark of banyan were measured in different animals. The animals were given orally doses of 300 and 600 mg/kg/day of body weight to the dietary fiber content of foods namely, khejri (*prsopsis*

cinceria), peepal banti (*Ficus religiosa*), banyan (*Ficus bengalensis*), gullar (*Ficus glomerata*) and tents (*Capparis decidua*) mottled from 38.5% to 55.7%. Fibre from all these plant foods, fed at the 10% dietary levels to rats. Results showed that banyan extract were of high potential anti-inflammatory activity [28].

9.2.5. Immunomodulatory

The aerial parts of FB showed to have immunomodulatory activity. The immunomodulatory action of the aerial roots has effects on both specific and non-specific immunity. Methanolic extract of the root was found to exhibit prominent increase in the fraction of phagocytosis [29]. In another study, it was proven that the extract exhibited a significant increase in the percentage of phagocytosis in human neutrophils. It was found that the extract can elevate hypersensitivity reactions in a dose dependent manner, it also resulted in a connotation elevation in the antibody titer value [30].

9.2.6. Wound healing

The reason of the efficacy of FB plant to heal the wounds remains unknown for a long time. In this case, chemical components responsible for the wound healing were unknown. But later on, after the identification of chemical components responsible for the wound healing, it was found that FB also contains that chemical constituents and is an effective wound healing agent [31].

9.2.7. Antistress and antiallergic

Different extracts of FB bark were used as an antiallergic and antistress therapy. The extracts were given to patients with asthma in milk resulting in leucocytosis and eosinophilia. Aqueous and ethanolic extracts revealed that there is a prominent decrease in the amount of leucocytes and eosinophils. While petroleum ether and chloroform extracts were proved to be inactive. Hence, bark work as anti-stress and anti-allergic agent in asthma [32].

9.2.8. Hypoglycemia

In many studies, the hypoglycemic effect of bark which is isolate from FB was evaluated. It was found that bark has antidiabetic properties. The hypoglycemic consequence of the bark was demonstrated in alloxan diabetic rabbits for first time and then in human beings [33].

9.2.9. Antipyretic activity

The antipyretic action of bark from banyan was studied in the Brewer's yeast-induced pyrexia in rats. The analgesic effects of different bark extracts of banyan might be due to the flavonoids and phenolic compounds. It was concluded that the various extracts of the bark of FB show analgesic and antipyretic effects which may due to the presence of bioactive components in the extract [34]. Furthermore, it was also tested by some research by using acetic acid induced twisting model on rats, it showed significant analgesic activity [35].

9.2.10. Antidiabetic

One of the most important medicinal applications of banyan is its antidiabatic activity. Different aerial parts of FB were comparatively used for their activity on blood glucose down regulation. Fruits lowered the blood glucose concentration more beneficial than the root or bark. The antidiabetic effects of aqueous extract of aerial roots of FB is due to the presence of specific glycemic element (calcium and magnesium) in high concentrations [36].

10. Summary

Banyan tree is a perennial plant belonging to the mulberry family (Moraceae). It has been of cultivated throughout the world and used for thousands of the year for ornamental plant and in traditional medicine. Mostly banyan contains flavonol, querecitin-3-glactoside, β sitosterol and rutin. The extent of each of these cheimcal constituents varies depending upon the type of species or cultivars as well as cultivation conditions such as soil type, weather and pH of soil where it grow. Bioactive peroxides are used as anticancer, antiviral, antidiabetic, and against malaria, as well as cardio-protective, hepato-protective, and neuroprotective effects. In Ayurvedic system, bark of the trees was used as a remedy for the treatment of diabetes.

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